

# **Handheld Augmented Reality Project [HARP]**

**by**

**Matt Dunleavy**

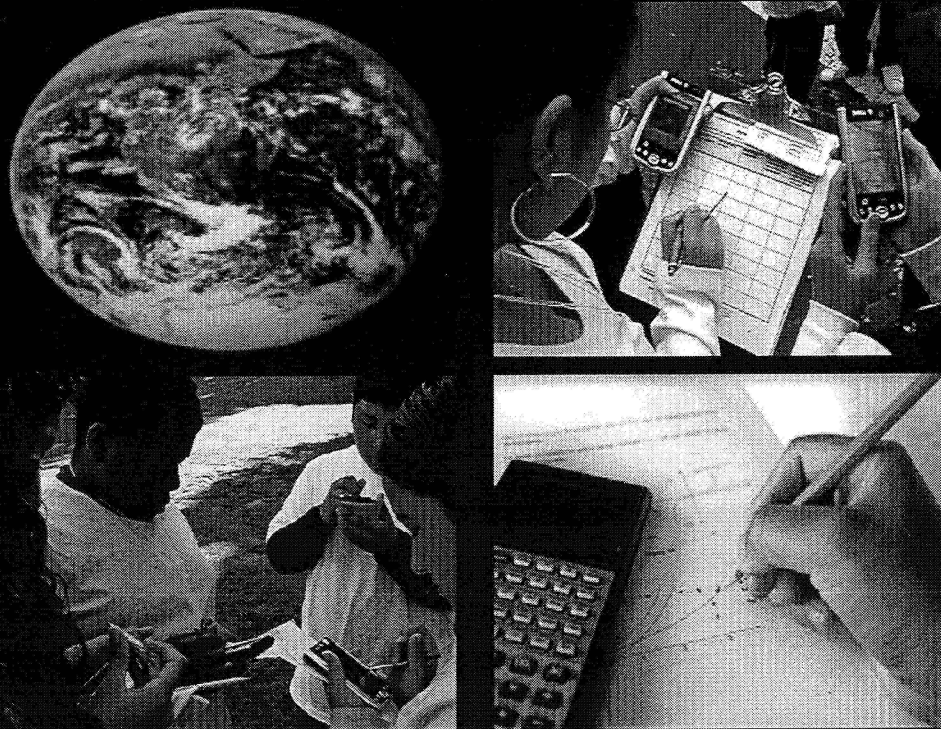




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# Handheld Augmented Reality Project (HARP)

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# Project Overview

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## ✦ U.S. Department of Education: Star Schools

- ✦ Three-year federal grant (2nd year)
- ✦ Focus: math and literacy
- ✦ Focus: under-served urban middle school students and teachers



# Project Overview

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- ⊕ Collaboration among four communities:
  - ⊞ University of Wisconsin at Madison
  - ⊞ Massachusetts Institute of Technology (MIT)
  - ⊞ Harvard University (HARP)
  - ⊞ Co-Researcher Teachers & Students



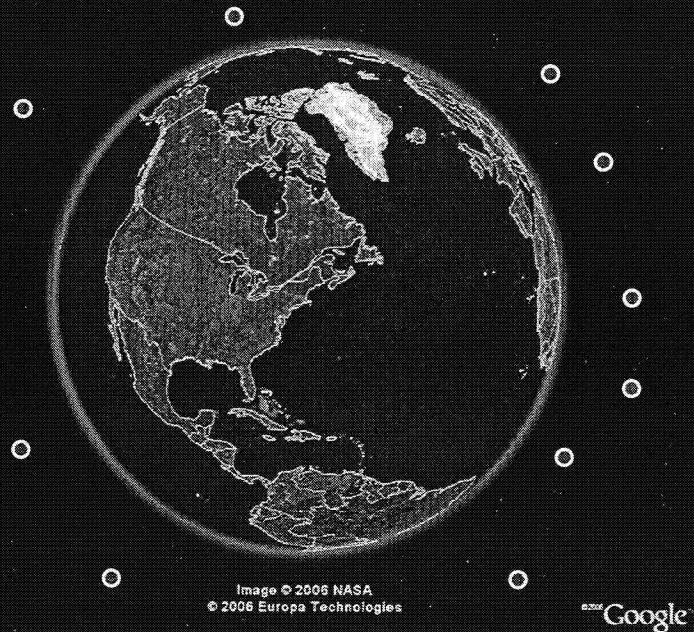
# Project Goal

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- ⊕ To design and study engaging and effective augmented reality learning environments using wireless handheld computers equipped with global positioning system (GPS) receivers

# Global Positioning System (GPS)

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- ✦ Satellite-based navigation system
- ✦ 24 satellites orbit the earth twice a day
- ✦ Originally placed in orbit by the Department of Defense
- ✦ Car navigation, camping, etc.



# GPS & Handheld Computers



Image © 2006 NASA  
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- ✦ Students have a handheld & GPS receiver
- ✦ Signals from at least 3 satellites triangulates the student's physical location





# Reality

**The games are played  
in the physical  
environment.**

**The GPS tracks the students'  
location as they explore  
the "game space."**



MassGIS, Commonwealth of Massachusetts EOEA  
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# Reality





# Augmented Reality



⊞ Students' physical location

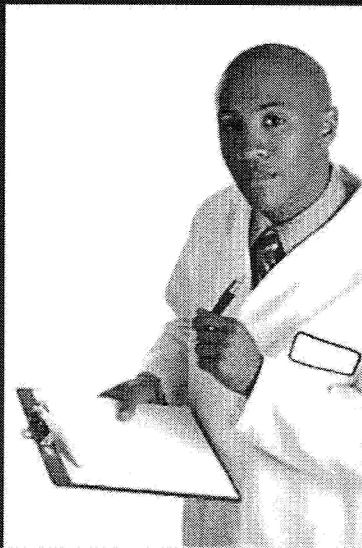
⊞ Characters & items the student encounters



# Exploring Augmented Reality

As students come within approximately 30 feet of these GPS points, they...

Meet virtual characters



Gather and read documents

The ratio of mission failures to mission successes in the 1960's is the 4th digit in the 4-digit code that unlocks **Evidence Building 2**. Remember that a ratio can be written as a fraction! It's OK to solve this problem as a team!

Year	Country	on Mars?
1960	USSR	Failure
1960	USSR	Failure
1962	USSR	Failure
1962	USSR	Failure
1962	USSR	Failure
1964	US	Failure
1964	US	Success
1964	USSR	Failure
1969	USSR	Failure
1969	USSR	Failure
1969	US	Success
1969	US	Success

»» You may want to write down your answer and share it with your teammates!

View photos and video clips





# Alien Contact!

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- ⊕ Aliens have landed on Earth and seem to be preparing for a number of actions including, peaceful contact, invasion, plundering, or simply returning to their home planet.
- ⊕ Working in teams (4 students per team), the students must explore the augmented reality world, interviewing virtual characters, collecting digital items, and solving mathematics and literacy puzzles to determine why the aliens have landed.





# Augmented Reality & Learning

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- ⊕ As students encounter these characters and items, they are given multiple tasks requiring math and literacy skills
- ⊕ Solving ratio, scale, and proportion problems and translating Latin roots to solve the Alien mystery



# Collaboration & Interdependence

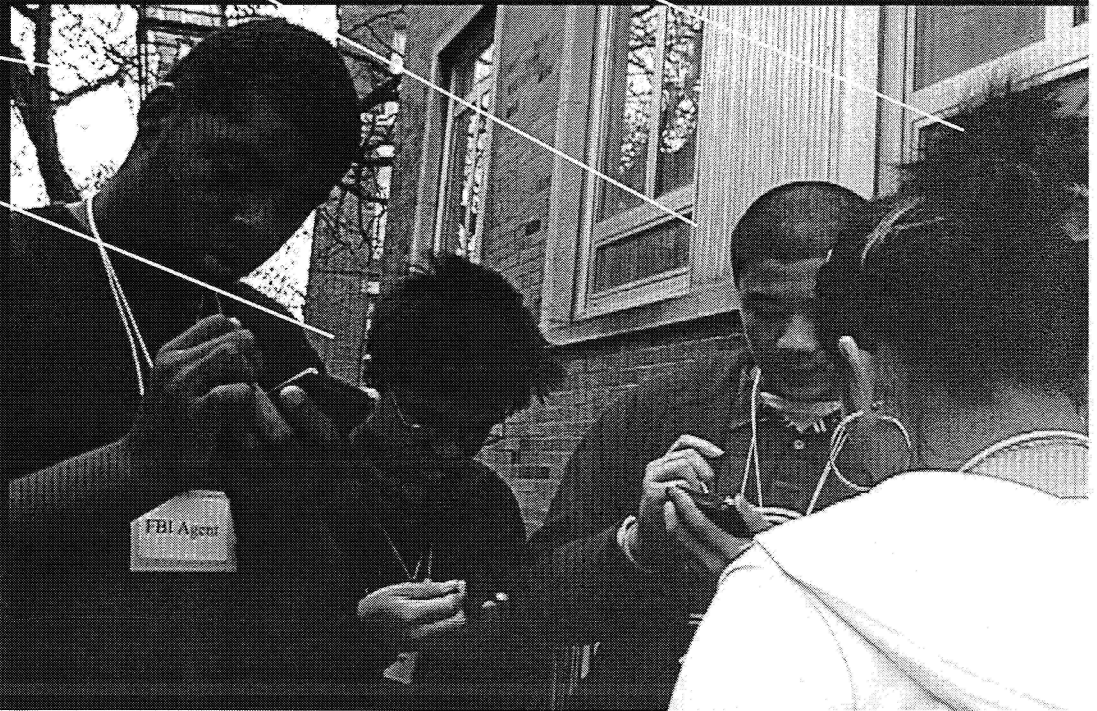
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...Chemist

...Linguist

...FBI  
Agent

...Computer Expert





# Augmented Reality



⊞ Student's physical location

⊞ Characters & items the student encounters



# Place Independent

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- ⊕ We can superimpose our simulations and games onto any school on the globe.





# Massachusetts Standards Aligned

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- ⊕ Ratio, proportion, and indirect measurement (Math Standard 6.M.3, 8.M.4, 8.N.3)
- ⊕ How English vocabulary has been influenced by Latin and Greek languages (ELA Standard 4.18, 4.21, 4.24)
- ⊕ Additional Math and ELA standards are embedded within the unit, such as reading graphs (Math 6.P.6, 8.D.2) as well as group discussions and presentations (ELA 2.4, 3.8, 3.9, 3.11, 3.13).

# Research Methodology

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- Design-based Research (Mixed Methods)
  - Year 1 Focus on the contextual variables shaping:
    - 1. Desirability
    - 2. Practicality
    - 3. Effectiveness
  - What are the conditions for success?
  - Piloting our methods and instruments



# Year 1 Findings

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- High student engagement
  - Unanticipated competition between teams
  - Unanticipated desire for “The” answer
- High level of collaboration & teamwork with important exceptions
- Significant level of student frustration resulting from complexity & length of activities
- Significant level of logistical support & management



# High Student Engagement

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I love this research being conducted! It gave us a chance to go out of school to learn math and English...This has been fun and I hope you guys come back (*Student Chat Room Posting 11/19/06*).

Some of the kids who are on IEPs...I did notice the kids with ADD, there are a couple kids that will not sit in class at all and they were 100% engaged (*Teacher Interview 6/8/07*).

I love how engaged the kids were...I liked what it did for the kids. I think it is extremely interesting (*Teacher Interview 6/8/07*).

I thought the thing (Alien Unit) was pretty cool because of how we mixed math and ELA with fun activities and how you guys made us learn stuff, but you also mixed some fun with it and I really like that (*Student Interview 6/8/07*).

We are not helping anybody, we want to win (*Observation Field Note 4/2/07*).





# Significant Collaboration, Teamwork, & Inquiry-based Learning

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We all needed each other to send the pictures we got to connect the puzzle so that is how we came up with our hypothesis (*Student Focus Group 11/22/06*).

Everyone had to participate to get the one answer (*Student Interview 11/22/06*).

You needed everyone's help to figure out the code (*Student Interview 4/9/07*).

I like this project because...we need each other and that makes us know each other more and better teamwork because in other projects some people do all the work and some people don't, but now we are all equal and we all do the same work (*Student Interview 6/8/07*).



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# Cognitive Overload, GPS Error, & Frustration

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...some of the codes were confusing...so we just like gave up (*Student Interview 11/14/06*).

A few of them said that they were clueless the entire time. It was too tough to try to learn the technology while also solving problems at the same time (*Teacher Interview 4/2/07*).

...synthesizing is a difficult skill for 6<sup>th</sup> graders and this program requires a significant amount of consensus and synthesis (*Teacher Interview 6/8/07*).

Sometimes the GPS is wrong (*Student Interview 6/8/07*).

My GPS didn't work for like 10 minutes and I had to keep my team back (*Student Interview 6/8/07*).





# Logistical Support & Management

Getting the kids out there, handing out the handhelds, getting all the glitches figured out, doing the activity, recollecting the handhelds, and getting them back into the building absolutely limits what you can do (*Teacher Interview 6/11/07*).

Set Up...



Hand Out...



Maintain GPS...



It has been...labor intensive...I feel like if we weren't flexible then it could have totally crashed and burned...it was a lot of work (*Teacher Interview 6/8/07*).



# Next Steps

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- Simplification of design to increase practicality:
  - ⊕ Logistical support and data collection is prohibitively time intensive to do both well;
  - ⊕ Implementation support is intensive and not practical for scalability;
  - ⊕ Complexity of current curricula need to be simplified to increase sustained student engagement and decrease teacher management overhead.
- Conduct more AR implementations:
  - ⊕ Explore potential strengths and weaknesses of AR
  - ⊕ Scratching the surface...



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Interested in participating? Email  
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## **VII. Poster Session**